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Identifying firms that win and lose from Danish food industry policy

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Abstract

Policy impacts on Danish food industry firms are investigated. A methodology is presented that focuses on classification of firms as winners and losers, and on the explanation of patterns of firms' variation within that classification. Survey data from 2003-2004 are used to define winners and losers from 30 regulatory areas drawn from a study of Danish food-related policy. The regulatory areas extend well beyond farm and rural policy to embrace "new food policy". Two statistical procedures are used to identify association between regulatory areas, types of firms, and patterns of winning and losing. The type of firm, rather than the policy instrument, appears to determine patterns of winning and losing. Firms that own assets upstream and downstream from their primary business, and are orientated toward exports and/or imports, are shown to exhibit patterns of winning and losing that conform to the models used. Winning and losing from several policy areas is found not to be associated with any specific firm type. Across all policy areas, firm size was found to be weakly associated with patterns of winning and losing.

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Preface

This report is a part of the 3-year project "Perspectives for Development of the Danish Food Sector". The project targets the policy environment surrounding the Danish food marketing chain,[1] and has objectives:

1. to measure changes in function, structure and commercial practice in the Danish food industry, and compare and contrast these with developments in other countries;
2. to characterize vertical and horizontal relationships in the Danish food chain, and their role in efficiency;
3. to evaluate the efficiency and competitiveness of the Danish food system at each stage of the marketing chain;
4. to review and evaluate instruments of Danish, EU and foreign public policy in the development of the food marketing chain; and
5. to communicate research results in a number of media.

The research reported here is associated with objectives 2, 3 and 4. It offers a new approach to examining the impacts of food-related policy on the food industry. It presents an explicit definition of, and classification mechanism for, "winners, neutrals, and losers" from food industry policies. From a survey of Danish food industry firms, a unique set of firm-level data is generated, entailing firms' statements about policy impacts.

The participation of food industry firms in the survey is gratefully acknowledged. Thanks are extended to Jørgen Dejgaard Jensen for substantial commentary on early drafts of this report.

[1] The project is partially funded by the Innovations Law of the Danish Ministry of Food and Agriculture. A full description of the project is available at ***www.dfk.foi.dk***. For further information please contact the author.

1. Background

1.1. "New food policy"

The policy environment in the food industry has undergone rapid recent change. A "new food policy" has been described, featuring such shifts in emphasis as "from rural to urban", "from shop to supermarket" and "from technology to competition" (Maxwell and Slater, 2003). Such changes reflect food industry development toward more vertical co-ordination (Boehlje and Sonka, 1998), the accompanying change in competitive conditions (Cotterill, 1997) and a range of consumer concerns about the environment and food safety (Brouwer and Bijman, 2001), ethics (Blandford and Fulpini, 1999) and various demographics (Kinsey and Senauer, 1996). This paper addresses a gap in the available research, resulting from past emphasis on policies related to farm income maintenance, rural development and protection of consumers' financial interests.

The Danish food industry is consolidating rapidly at processing, distribution and retail stages (Baker, 2003), and encounters an increasing number of policy instruments that are of the "new food policy" type (Hamann and Baker, 2004). Danish food industry firms list "regulation" amongst the most serious problems they face, both individually and as an industry (Baker et al. 2004). This paper uses a survey of Danish food industry firms to analyse the impacts of 30 nominated regulatory areas on those firms.

1.2. "Winners and losers"

There is an elemental appeal to the identification of winners and losers from policy instruments. It is widely used in political debate, but is not subject to objective measurement nor related to specific policies. This paper develops an empirical methodology for identifying individual firms that win and lose from compliance with specific policies.

Food industry firms' costs of policy compliance have been calculated under a range of assumptions for strictures such as elements of food safety at the industry level (e.g. Antle, 2000) and more rarely, at the firm level (e.g. Jensen et al., 1998). Few studies have examined both costs and benefits to a sample of different firms to the extent that patterns of winning and losing can be identified. Firms' attributes have rarely been examined in this connection, although one example is the question of whether large firms find it cheaper to implement HACCP systems than do small firms (Siebert et al.,

2000). In this paper, firms' survey[2] responses are processed to identify winners and losers, and information on firms' attributes is used to identify the types of firms that win and lose from each policy.

1.3. Policy areas

Listing of the elements of specific regulatory areas, and intuitive projections of their impacts on food industry firms has targeted, for example, competition policy (Buccirossi et al., 2002) and food safety, research and development, and labelling (Henson et al., 1995). Hamann and Baker (2004) have carried out this exercise for 12 food-related Acts of the Danish Parliament, which give rise to the 30 legislative areas examined in this study.

2. Data and analytical approach

2.1. Survey

The survey of Danish food industry firms was conducted between November 2003 and February 2004. A sample of 940 food processing and distribution firms was assembled from a variety of sources. After rejections for duplication, industry exit and merger, 700 firms were contacted by telephone and invited to participate in the survey. A second telephone call was used to remind participating firms, and eventually 109 completed questionnaires were received (a 16% response rate). Of the respondents, 69 were food processors, 29 were food distributors, 9 were input suppliers and 4 were other actors in the food marketing chain. The relevant Danish populations are believed to be about 350 food processors,[3] and about 600 food distributors and input suppliers (Baker, 2003).

The survey questionnaire sought basic information on firms' size, structure and activities, and firms' views of the impact of 30 specified regulatory areas. The list of regulatory areas was compiled from a review of the legal basis of Danish food industry policy (Hamann and Baker, 2004). Policies targeted at the farm stage of the food chain (e.g. most Common Agricultural Policy instruments) were omitted from the list because the survey focuses on food industry firms, and because the 30 regulatory areas were possibly the practical limit for a questionnaire.

[2] For detail of the survey and a complete list of results, see Baker et al. (2004).
[3] Excluding a large number of small bakeries and patisseries.

Firms' assessments required ticking boxes to indicate whether cost and price categories would, as consequence of compliance with each policy, "rise", "fall" or have "no impact" (see table 1). Firms were also permitted to claim "don't know", and to not respond. It should be noted that no measures of the extent of changes in prices and costs are delivered by the survey, only the directions of those changes. This approach reflects the commercial sensitivity of such information and the need for a standard form of firms' responses.

2.2. Typing variables

Descriptive data about the firms (collected in the first part of the questionnaire) were used to identify "types" of firms according to their size, commodity sector specialisation, form of ownership, stage of food chain, degree of vertical integration, branding behaviour, trade intensity, etc. These variables are henceforth referred to as "typing variables", a list of which (with definitions and forms) is presented in table 2.

Table 1. Survey questions on policy impacts

Instructions to firms:
"Please evaluate each of the following government policies on the price and cost aspects of your firm's operations"

	SALES PRICES					PURCHASE PRICES					FIXED COSTS					VARIABLE COSTS				
	In 2002, this policy resulted in prices to customers being ...					In 2002, this policy resulted in PRICES PAD to SUPPLIERS of agricultural and food products being ...					In 2002, this policy resulted in this firm's FIXED costs of production being ...					In 2002, this policy resulted in this firms VARIABLE costs of production being ...				
	Higher	Neither higher nor lower	Lower	I don't know		Higher	Neither higher nor lower	Lower	I don't know		Higher	Neither higher nor lower	Lower	I don't know		Higher	Neither higher nor lower	Lower	I don't know	
International trade policy for raw agr. products under the CAP	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
International trade policy for processed foods & feeds under the CAP	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
Legislation related to farmer co-operatives	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
legislation on animal welfare during production	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
Legislation on animal welfare during transport and handling	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
Rules of product nomenclature	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
Rules of prod. quality descrn. when raw materials are purchased.	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
Rules of prod. quality descrn. when products are sold	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
Rules on provision of information about GMO	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
Rules on provision of information about country of origin	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
Rules on provision of information about production methods	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
Rules on products' identify preservation, and traceability	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
Anti-monopoly legislation	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
Anti-trust legislation	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
Copyright and patent law	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
Product liability law	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
Food safety regulation	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
Rules on organic farming and organic food products	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
Legislation on recycling of packaging material	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
Legislation on water use	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
Legislation on waste water discharge	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
Legislation on solid waste disposal	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
Legislation on air quality	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
Legislation on land use and planning	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
Legislation on transport	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
Contract law – regulation of the content of contracts	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
Contract law – regulation of enforcement of contracts	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
Rules of accounting, record keeping and public disclosure	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
Labour law	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	
Regulations on business operating hours	☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐		☐	☐	☐	☐	

Table 2. Description of typing variables

Measure	Typing variable	Units/measure	Form taken
Firm size	Sales	Danish Kroner in 2002	Class Continuous
	Employment	Full-time equivalent in 2002	Class Continuous
Value-added	Sales per em-ployee	Danish Kroner per employee in 2002	Class (high, low) Continuous
Commodity Speciali-sation	Sector	Meat Fish Dairy Fruits and vegetables Alcoholic beverages Non-alcoholic beverages Other specialised Non-specialised	Class
Type of agent	Stage of chain	Input supply Processing Distribution Other	Class
Branding behaviour	Brand ownership	Number of brands owned in 2002	Class (high-low in sample) Continuous
	Use of retail own-brands	% of sales as retailers' own-label brands in 2002	Class (high-low in sample) Continuous
Trade intensity	Export intensity	% of sales exported in 2002	Class (high-low in sample) Continuous
	Import intensity	% of agricultural raw material purchases imported in 2002	Class (high-low in sample) Continuous
Vertical integration	Ownership of downstream assets	Number of (specified) assets owned downstream from firm's stage of food chain in 2002	Class (zero and non-zero) Continuous
	Ownership of up-stream assets	Number of (specified) assets owned upstream from firm's stage of food chain in 2002	Class (zero and non-zero) Continuous
	Vertical integration by ownership	% ownership by agents from outside the firm's stage of food chain in 2002	Class (zero and non-zero) Continuous
Ownership	Ownership outside food industry	% ownership by agents from outside the food industry in 2002	Class (zero and non-zero) Continuous
Diversification outside food industry	% of sales as food products	% ownership by agents from outside the firm's stage of food chain in 2002	Class (zero and non-zero) Continuous
Co-operative owner-ship	Co-operative form	Ownership by a co-operative in 2002	Class (Yes and No)

2.3. Classification of winners and losers

Firms' claims about cost and price movements associated with each legislative area are used to generate patterns that allow identification of winners (of two types), losers, and firms described as "neutral". The classification is shown in table 3. Two types of winner are identified because of the significance of firms' ability to pass policy-related costs onwards in the food marketing chain. Firms that win by doing this are referred to as "pass-through" winners. Firms that manage to raise prices due to this policy while not incurring the costs at all are referred to as winners that "add on".

Table 3. Classification of winners and losers

Classification of firm	Prices	Costs and purchase prices
Loser	Fall	Rise & no impact
Neutral	Other combinations & "don't know" & no response	Other combinations & "don't know" & no response
Winner (with pass-through)	Rise	Rise
Winner (by adding on)	Rise	Fall & no impact

The distribution of winners and losers, as defined in table 3, is shown in table 4 for all firms in the survey. For all policy areas, the majority of firms are "neutral". As many as 98% of firms are neutral to contract law (content of contracts) and 97% to contract law (enforcement of contracts). The lowest proportion of neutral firms is found to be associated with food safety regulation (55%) and solid waste disposal (56%) and legislation on water use (58%). The policy areas from which most firms claim to lose are labour law (20%), solid waste disposal (18%), and food safety regulations (17%).

Table 4 demonstrates firms' substantial variation in the pattern of winning and losing that is associated with the 30 policy areas. The analysis in section 3 attempts to identify patterns in that variation that might identify the characteristics of firms that predispose to their being winners or loses from each policy area.

Table 4. Distribution of winners and losers in all policy areas (all firms)

Regulatory area	Classification of firm: Loser	Neutral	Winner (with pass-through)	Winner (by adding on)
	% of all firms in sample			
International trade policy for raw agricultural products under the CAP	11	74	2	13
International trade policy for processed foods and feeds under the CAP	9	83	3	6
Legislation related to farmer co-operatives	1	94	1	4
Legislation on animal welfare during production	7	78	8	7
Legislation on animal welfare during transport and handling	6	77	7	10
Rules of product nomenclature	3	90	4	3
Rules on product quality description when raw materials are purchased	11	72	9	8
Rules on product quality description when products are sold	12	72	9	7
Rules on provision of information about Genetically Modified products	9	77	5	9
Rules on provision of information about products' country of origin	5	84	6	5
Rules on provision of information about products' production methods	6	82	8	4
Rules on products' identity preservation, and traceability	16	59	18	7
Anti-monopoly legislation (regarding pricing and competitive conduct)	3	96	1	0
Anti-trust legislation (regarding merger and acquisition)	3	92	2	3
Copyright and patent law	2	95	2	1
Product liability law	6	79	8	7
Food safety regulation	17	55	17	11
Rules on organic farming and organic food products	4	87	3	6
Legislation on recycling of packaging material	11	72	10	7
Legislation on water use	13	58	19	10
Legislation on waste water discharge	14	60	18	8
Legislation on solid waste disposal	18	56	17	9
Legislation on air quality	6	78	12	4
Legislation on land use and planning	2	98	0	0
Legislation on transport	8	79	5	8
Contract law - regulation of the content of contracts	1	98	1	0
Contract law - regulation of enforcement of contracts	0	97	1	2
Rules of accounting, record keeping and public disclosure	16	74	6	4
Labour law	20	63	10	7
Regulations on business operating hours	2	95	1	2

2.4. Relationships between typing variables' classes, and winners and losers

The typing variables are used in two ways to subdivide the surveyed firms. First, categorized typing variables are used, as class variables. Several typing variables (e.g. commodity sector and stage of chain) are available only as class variables, while others have been classified according to values observed in the survey. Differential policy impacts on large and small firms are of obvious interest, as are those due to firms' export and orientation and degree of value added. We examine all possible classifications of the typing variables, with particular emphasis on firms' abilities to pass on the costs of policy compliance down the marketing chain or to avoid paying

costs altogether (possibly by passing costs back up the chain to suppliers). Examples are presented in tables 5 and 6.

In table 5, firms' distributions of winners and losers are compared across commodity sectors for the impact of legislation on Genetically Modified Organisms (GMO). Some variation is observed: all firms in the survey that operate in the meat sector are classified as neutral to GMO legislation; while about 30% of firms in the dairy and grains sectors appear to be "winners" from GMO legislation. It is notable that the majority of "winning" dairy firms do so by passing on costs, while the majority of grains firms do so by raising prices while avoiding costs. Winning firms in most sectors appear to do so (by "adding on") in the same way as firms in the grains sector. Although it is intuitively appealing to conclude that GMO has differential impacts on commodity sectors, a statistical test is necessary to infer whether this is the case. Whether the sectors' observed distributions are significantly different from each other is investigated in section 3.

In table 6, a similar comparison is made for two classes of firms, created by subdividing the firms' values for revenue per employee into "low" and "high" categories, with reference to legislation concerning traceability of food products. Both classes of firm exhibit similar distributions of losing and neutral firms, the distribution of firms amongst the two types of winners is quite different. Firms with high revenue per employee appear to be better able to pass on the costs of policy compliance (22% of firms with high revenue/employee) than to avoid costs (just 2% of firms with high revenue/employee). This may be explained by value adding activities (branding, packaging, quality designation), which would utilise the information derived form traceability. As for table 5's results, a statistical test is necessary to draw inference from the patterns of winning and losing revealed in table 6. This is presented in section 3.

Table 5. Distribution of winners and losers from GMO legislation, by commodity sector

Commodity sector	Classification of firm: Loser	Neutral	Winner (with pass-through)	Winner (by adding on)
	% of all firms in sample			
Meat	0	100	0	0
Dairy	14	57	21	7
Grains	10	60	10	20
Fruits and vegetables	18	73	0	9
Fish	11	82	4	4
Other sectors	4	82	0	14
Non-specialised firms	17	67	0	16
All firms	9	77	5	9

Table 6. Distribution of winners and losers from legislation on traceability, by classes of revenue per employee

Revenue per employee*	Classification of firm: Loser	Neutral	Winner (with pass-through)	Winner (by adding on)
	% of all firms in sample			
Low	14	59	14	12
High	16	60	22	2
All firms	16	59	18	7

* defined as above or below the sample median.

2.5. Relationships between typing variables' magnitudes, and winners and losers

The second way that the typing variables are used is as continuous variables. Winning and losing firms from each policy area are seen to display different means for each of the typing variables: tables 7 and 8 provide examples. In table 7, mean values of typing variables are presented for firms classified as winners (of two forms), losers and neutral regarding food safety legislation. Firms that lose from food safety legislation appear to have, on average, about the same number of employees (first row of

table 7) than those that are neutral or win from that policy area, although the firms that win by adding on (right hand column), appear to have a smaller average number of employees (63) than do the other firms.

With regard to firms' trade intensity (second and third rows of table 7), average % share of exports in sales and % share imports in input purchases show quite different patterns. Firms that win from food safety legislation by passing on costs average just 18% of sales as exports while those that win by adding on average 44% of sales as exports. Firms that lose from, and are neutral to, food safety legislation have about the same export intensity (24% and 26% respectively). Firms' import intensity appears to be approximately constant across losers (47% of inputs are imported), neutrals (42%) and winners by passing through (41%), while firms that win by adding on import rather less (just 29%) of their inputs. In the final row of table 7, firms that win from food safety legislation by passing on costs feature just 7% of sales as retailers' own-label brands. This appears to be markedly lower than for losers, neutrals and winners that add on.

Table 8 presents a summary for the example of legislation on animal welfare during production. Firms that lose and firms that win by adding on appear to have the smallest numbers of employees (38 and 50, respectively). Firms that win from animal welfare legislation by adding on feature just 3% of sales as retailers' own-label brands (final row of table 8). In section 3, statistical analysis is used to identify relationships between the magnitudes of typing variables and firms' winner/loser classification for each of the 30 policy areas in the study.

Table 7. Mean values of typing variables for firms classified as winners and losers from legislation on food safety

Typing variable	Classification of firm			
	Loser	Neutral	Winner (with pass-through)	Winner (by adding on)
	Mean values for firms in sample			
Number of employees	104	171	159	63
% of purchases of agricultural raw materials that are imports	24%	26%	18%	44%
% of sales that are exports	47%	42%	41%	29%
Number of brands owned	2	8	3	1
% of sales that are retailers' own-label brands	21%	22%	7%	22%

Table 8. Mean values of typing variables for firms classified as winners and losers from legislation on animal welfare during production

Typing variable	Classification of firm			
	Loser	Neutral	Winner (with pass-through)	Winner (by adding on)
	Mean values for firms in sample			
Number of employees	38	149	283	50
% of purchases of agricultural raw materials that are imports	25%	28%	11%	27%
% of sales that are exports	45%	43%	23%	34%
Number of brands owned	1	8	3	1
% of sales that are retailers' own-label brands	35%	21%	25%	3%

3. Statistical analysis

3.1. Examination of firms' win/lose distributions by typing variables

The first statistical procedure examines the variation apparent in table 4, that policy areas are associated with a range of distributions of winning and losing amongst firms. Its aim is to identify typing variables that influence the distribution of winning and losing firms for each policy area.

The cross-tabulation procedure in SAS (1998) was used. This delivers a matrix of output similar to tables 5 and 6, with the distribution of firms (in terms of win/lose classification) related to the distribution of each typing variable (in terms of the class of the typing variable, detailed in table 2). Pearson's chi-squared statistic is used to test the null hypothesis that firms are distributed identically as winners, losers and neutrals, across all classes of each typing variable.

Rejection of the null hypothesis identifies typing variables that influence the likelihood of a firm being a winner or loser from a specific policy. The inference drawn is that firms in two classes of a typing variable (e.g. small and large firms) exhibit different distributions of winning and losing from compliance with an individual policy.

A total of 450 cross-tabulations were constructed: 30 policy areas by 15 typing variables. Some 20% of the cross-tabulations featured either an entire row or an entire column of zero values, and were eliminated from further analysis.

3.2. Examination of differences in typing variables' means by win/lose classification

The second set of statistical analyses used, where available, the continuous forms of typing variables. It examines the variation apparent in tables 7 and 8, to associate the means of each typing variable achieved by firms classified by win/lose for each policy area. For each typing variable, the means demonstrated by winners, neutrals and losers are compared using a series of paired comparisons, or a "multiple comparison procedure" (Hsu, 1996). Paired means tests used the SAS (1998) embedded Freeman-Tukey paired t-test procedures. The Freeman-Tukey procedure adjusts for potentially-spurious type I errors due to the large numbers of tests conducted. The null hypothesis is that for a given policy area, winners, neutrals and losers demonstrate the same mean for a given typing variable.

Rejection of the null hypothesis identifies relationships between the magnitude of the typing variable and the likelihood that a firm will win from, lose from, or be neutral toward, each policy. Two forms of inference can be drawn. The first is that the sign of relationships between typing variables and win/lose distributions can be identified (e.g. are larger firms associated with losing from this policy area, or is it smaller firms?). The second is that relationships amongst win/lose classifications can be derived (e.g. are higher or lower values of a typing variable associated with a firm being able to win by pass-through, rather than by adding-on?).

A total of 360 paired means tests were carried out: 12 continuous typing variables by 30 policy areas. For each paired means test, 6 comparisons are made, labelled A-F in table 9.

Table 9. Classification of results from paired t-tests

Firms classified as…	… have a mean of the typing variable significantly different to firms classified as …			
	Loser	Neutral	Winner (with pass-through	Winner (by adding on)
Loser		D	E	F
Neutral			B	C
Winner (with pass-through)				A
Winner (by adding on)				

3.3. Relationship between the two statistical analyses

The tests of equivalence of distributions provide inference about whether the numbers of winners and losers is affected by the typing variable for each policy area. The paired tests of winners, losers and neutrals' means for each typing variable identifies specific relationships between typing variables and the distribution of winners and losers.

The strength of the test of equivalence of distributions is that it signals the presence of any significant relationship. This is important where multi-modal outcomes are possible: for example where a policy affects very large and very small firms but not middle size firms. The procedure has two weaknesses. The first is that it does not identify the "direction" of the relationship, in that significantly-different distributions are not necessarily associated with the magnitudes or class of typing variables. Its second weakness in the current context is that it tends to be dominated by neutral firms, as for each policy area this is where the bulk of the distribution lies. More subtle relationships, such as between the two forms of winner identified in this study, may be overlooked.

The strength of the paired means tests is that every possible relationship in table 9 is assigned appropriate degrees of freedom, so that there is no dominance by neutral firms. The weakness of the paired means tests is that only "linear" relationships are identified by rejection of the null hypothesis. The multi-modal outcome as described above would not be detected.

4. Results

4.1. Tests of distributions of winners, losers and neutrals

The results of the tests of distribution are shown in table 10. Each column of table 10 represents a typing variable, and each row a regulatory area. Each cell represents a statistical test for the significance of the typing variable in determining the distribution of firms as winners and losers due to a given policy.

Note that in this test, the typing variables have been broken into classes ("high", "low", etc). Where firms in the different classes of the typing variables display statistically significant (at 10% level of the test) distributions amongst winners, losers and neutrals, an asterisk (*) appears in table 10. The right hand column in table 10 re-

cords the total number of typing variables that are significant for each regulatory area. The bottom row records the total number of regulatory areas for which each typing variable demonstrates different distributions of winners and losers.

For two legislative areas (recycling, and on solid waste disposal) no typing variables yield classes that have significantly different distributions of winners and losers. The inference drawn is that we cannot identify, from this analysis, any particular type of firm that wins or loses from these two policy areas.

The regulatory areas associated with the largest number of significant typing variables are animal welfare during transport and handling (5 typing variables), copyright and patent law, and regulations on business operating hours (both with 4 significant typing variables). The inference drawn is that regulation of animal welfare during transport and handling (for example) affects different types of firms in different ways. In particular, different distributions of winners, losers and neutrals have been identified for firms: at different stages of the food marketing chain; with different usage of retailers' own brands; with different export intensities; with different levels of ownership of upstream assets; and with different levels of specialisation in the food industry (sales of food products as a % of all sales).

Amongst typing variables, just one exhibits no statistically significant association: number of employees. The other measure of firm size (annual sales) shows significantly different patterns of distribution of winning and losing in 3 policy areas: product liability, food safety, and accounting rules.

The typing variable that appears to influence firms' winning and losing from the largest number of policy areas is export intensity (10 policy areas), followed by two different measures of firms' vertical integration (8 policy areas each). Firms' export intensity (the % of all sales that are exported) influences the distribution of winners, losers and neutrals that results from: animal welfare regulations (both at production and processing stages); required provision of information (2 forms of quality description, GMO-content, trace-ability, country of origin, organic status); antimonopoly regulation and accounting rules.

Table 10. Form of relationship between typing variables and winning and losing, by legislative area

	Typing variables (by class)															
	Firm size					Branding behaviour		Trade intensity		Vertical integration						
Regulatory area	Sales	Employment	Sales per employee	Sector	Stage of chain	Brand ownership	Use of retail own-brands	Export intensity	Import intensity	Ownership of downstream assets	Ownership of up-stream assets	Vertical integration by ownership	Ownership outside food industry	% of sales as food products	Co-operative form	Number of significant typing variables
International trade policy for raw agricultural products under the CAP											*	*				2
International trade policy for processed foods and feeds under the CAP					*							*				2
Legislation related to farmer co-operatives					*											1
Legislation on animal welfare during production					*			*			*					3
Legislation on animal welfare during transport and handling					*		*	*			*			*		5
Rules of product nomenclature							*									1
Rules on product quality description when raw materials are purchased							*	*								2
Rules on product quality description when products are sold											*	*				2
Rules on provision of information about Genetically Modified products								*								1
Rules on provision of information about products' country of origin								*								1
Rules on provision of information about products' production methods				*				*		*						3
Rules on products' identity preservation, and traceability								*				*	*			3
Anti-monopoly legislation (regarding pricing and competitive conduct)								*						*		2
Anti-trust legislation (regarding merger and acquisition)													*			1
Copyright and patent law			*			*					*			*		4
Product liability law	*								*							2
Food safety regulation	*										*					2
Rules on organic farming and organic food products			*					*	*							3
Legislation on recycling of packaging material																0
Legislation on water use												*				1
Legislation on waste water discharge				*	*	*										3
Legislation on solid waste disposal																0
Legislation on air quality												*				1
Legislation on land use and planning											*			*		2
Legislation on transport														*	*	2
Contract law - regulation of the content of contracts												*				1
Contract law - regulation of enforcement of contracts					*							*				2
Rules of accounting, record keeping and public disclosure	*							*								2
Labour law														*	*	2
Regulations on business operating hours				*					*		*			*		4
Number of significant regulatory areas for each typing variable	3	0	2	3	6	2	3	10	3	1	8	8	2	7	2	

* significance at 10% level of test, revealed by Pearson's chi-squared statistic.

The significance of firms' export intensity is to be expected. Animal welfare regulation concerns may affect exporters less than those serving the Danish market, and exporting firms may be able to choose markets in which they can be sure to pass on compliance costs to their customers (e.g. Danish pork products in the British market). Similarly, information-related policies (including rules on organics) are likely to affect firms differently, depending on the location of the final consumers. Import intensity as a typing variable is far less influential, but intuitively sound: Danish rules on organics and food safety are likely to raise costs for importing firms, as demonstrated in the results.

A notable result is that firms' sector orientation (see fourth column of table 10) is less important in determining policies' impacts on a firm than is the stage at which it operates in the marketing chain (fifth column of table 10). Firms' stage of the food chain is significant in determining patterns of winning and losing from policy related to animal welfare, trade barriers, legal aspects of co-operatives' operation, and accounting rules. Firms' sector of operation is influential in firms' winning and losing from policies on information provision about production methods, waste water discharge and business operating hours: all three of which are policy areas that intuition would suggest are sector-specific.

Two of the three typing variables associated with vertical integration show strong significance. Firms show significantly different distributions of winners and losers due to variation in their ownership of upstream assets (column 11 of table 10) and the extent of ownership by firms from other stages in the food chain (column 13 of table 10). However, distributions of winners and losers for these two typing variables are affected by different sets of policies. Ownership of upstream assets affects the distribution of winners and losers from trade policy, animal welfare and food safety regulation, as well as land use planning rules and rules on business operating hours. Variation in vertical integration by ownership, on the other hand, is associated with contract law (most relevant to non-integrated firms) and with traceability and quality description (often subject to contracts). These results all conform to expectations.

Ownership from outside the food industry is the only typing variable in table 10 found to be related to anti-trust policy. It is not clear whether firms from outside the food industry actually face different procedures for acquisition than do food industry firms, but the perception has appeared in this survey.

Firms' branding behaviour is significant in determining patterns of winners and losers. Variation in numbers of brands owned is associated with differential impacts of copyright law, as might be expected. Use of retailers' own-label brands is, also as expected, associated with regulations on product nomenclature and quality descriptions.

Several cases of unexpected associations arise. These include the association between use of retailers' own-label brands and animal welfare legislation, and the result that co-operative ownership is a factor in determining winners and losers from labour law.

4.2. Tests of nature of relationship between typing variables and winners and losers

Table 11 summarises the relationships between firms' values for continuous typing variables and firms' status as a winner (of two possible types), loser or neutral. Non-empty cells in table 11 indicate a statistically-significant difference between the mean of the typing variable for each of winners by pass-through, winners by adding on, neutrals and losers. Non-empty cells contain a letter (A-E) and a sign (+ or -). The letter corresponds to the result classification in table 9. The sign indicates the nature of the relationship between value of the typing variable and the firms' classification as a winner or loser: a positive sign denotes that means of the typing variables for winners are significantly higher than means for neutrals, etc.

The most striking aspect of table 11 is its difference in configuration from table 10. This is due to the nature of the typing variables in each case. Taking values of export intensity (column 6 of table 11) as an example, only 1 policy area (information provision about GMO) yields a significant result. In table 10 (column 8) differences in distribution of winners and losers from 10 policy areas were identified. For this example, the "F-" result in table 11 indicates that high levels of export intensity are associated with firms being losers, rather than winners by adding-on, from regulations on GMO-related information provision. For GMO, we identified no other pairs of means for typing variables that were significantly different.

By way of contrast, the "ABCDEF-" results for both animal welfare policies (rows 4 and 5, column 9 of table 11) indicates that a firm's high levels of ownership of upstream assets is associated with losing from animal welfare regulations rather than being neutral or winning, being neutral rather than winning, and winning by pass-through rather than by adding-on. In this case, the tables 10 and 11 conform: owner-

ship of upstream assets is shown to significantly influence the distribution of winners and losers from both forms of animal welfare regulation.

The second striking feature of table 11 is the repeated appearance of the designation "A" for tests involving four of the typing variables (sales per employee, use of retail brands, and ownership of upstream and downstream assets), but not other typing variables. This indicates that those typing variables are significant in determining whether firms win by passing on cost increases or by avoiding cost increases but taking advantage of policy-induced price increases. Notably, the incidence of "A" is observed across a range of regulatory areas (rows of table 11), while being confined to a narrow range of typing variables (columns of table 11). This indicates that the type of firm is the decisive factor in the form of winning they display, and not the regulatory area that they win from.

In table 11, firms' size (measured either in sales or in number of employees) is shown to be unrelated to firms' winning and losing from the regulatory areas studied here. High levels of import intensity are shown to be associated with firms that lose, rather than be neutral or win, from CAP-related trade barriers and rules on organic foods. These more subtle relationships are not detected by comparison of distributions in table 10.

Positive signs in the bottom row of table 11 indicate that regulations on shop opening hours favour firms with high levels of import intensity and firms for which food products are a high share of all sales. Table 10's tests of distributions confirm those results, as well as showing that sector (a class variable) is significant in determining the impact of legislation on shop opening hours. These results are intuitively sound: Danish law on shop opening hours discriminates between retail enterprises according to size. Although no retailers participated in the survey, the impacts are clear: small retail shops (permitted to be open longer hours) tend to sell fresh vegetables and dairy products, but not meat and fish, so the significance of "sector" is indirect, but entirely logical.

Table 11. Relationship between firms' values of typing variables and firms' classification as winner and loser

	Typing variable (as continuous variables)											
	Firm size			Branding behaviour		Trade intensity		Vertical integration				
Regulatory area	Sales	Employment	Sales per employee	Brand ownership	Use of retail own-brands	Export intensity	Import intensity	Ownership of downstream assets	Ownership of up-stream assets	Vertical integration by ownership	Ownership outside food industry	% of sales as food products
International trade policy for raw agricultural products under the CAP							D -	DF-				
International trade policy for processed foods and feeds under the CAP							DE -	DEF-	CF+			
Legislation related to farmer co-operatives								ACF+				
Legislation on animal welfare during production								C +	ABCDEF-			
Legislation on animal welfare during transport and handling								ACF+	ABCDEF-			F-
Rules of product nomenclature					D-							
Rules on product quality description when raw materials are purchased									ACF+			
Rules on product quality description when products are sold								DF -				
Rules on provision of information about Genetically Modified products						F-		ACF+	DEF-			
Rules on provision of information about products' country of origin								ACF+	DEF-			
Rules on provision of information about products' production methods								ACF+				
Rules on products' identity preservation, and traceability												
Anti-monopoly legislation (regarding pricing and competitive conduct)					D-							
Anti-trust legislation (regarding merger and acquisition)												
Copyright and patent law									D-			
Product liability law								ACF+				DEF+
Food safety regulation								CF+				
Rules on organic farming and organic food products							DE -					
Legislation on recycling of packaging material												
Legislation on water use								ABE+	DEF-			
Legislation on waste water discharge								BCEF+	DEF-			
Legislation on solid waste disposal								BCF+		D+		
Legislation on air quality								ACEF+				
Legislation on land use and planning												D+
Legislation on transport							CF+					C-
Contract law - regulation of the content of contracts												
Contract law - regulation of enforcement of contracts			AB+							C+		
Rules of accounting, record keeping and public disclosure			ABE+		A+							
Labour law												
Regulations on business operating hours							F+					DEF+
Number of detected significant relationships	0	0	2	0	3	1	5	15	9	2	0	5

All non-empty cells show relationships significant at 10% level of test, revealed by Freeman-Tukey paired t-test.

In both tables 10 and 11, ownership of upstream assets generates very different configurations of winners and losers from each policy. Also in both tables, its influence is much different from that of ownership of downstream assets. In table 11, firms with high levels of downstream asset ownership gain from animal welfare legislation, policies involving information provision, food safety and product liability law, and environmental legislation (a + sign in table 11). Conversely, firms with high levels of upstream asset ownership tend to lose from the same policies (a – sign). The explanation may be that firms that integrate downstream already have experience with compliance with legislation on animal welfare, information provision and food safety in implementation and management, so that they have learned to pass on costs on or avoid them altogether. Conversely, firms that integrate upstream may lack that experience, and confront new sets of costs as a consequence of vertical integration.

In table 11, relationships between continuous measures of branding behaviour and winner/loser classifications are weak (columns 4 and 5). The number of brands owned is not associated with winning and losing from any policy area. Firms with a high share of sales of retailers' own-label brands tend to be losers from product nomenclature law, rather than being neutral to it. Similarly, they lose from antimonopoly regulation. No strong arguments can be made, from the available information, to comment further on those results.

5. Discussion and conclusions

5.1. Overview

This paper offers a new approach to examining the impacts of food-related policy on the food industry. It presents an explicit definition of, and classification mechanism for, "winners, neutrals, and losers" from food industry policies. A unique set of firm-level data is used, and firms' statements about policy impacts are utilised. The analysis involves Danish firms and the impact of policies as implemented in Denmark.

The classification of winners and losers recognises that firms in the food marketing chain have the potential to pass on costs to their customers. This is an element of the modern food marketing that is frequently referred to in policy analysis, but is rarely quantified by firm-level data or in statements by firms. Similarly, firms that avoid compliance costs altogether but benefit from consumers' willingness to pay for compliance-related attributes (e.g. food safety or animal welfare) are not usually ac-

counted for in policy analysis. For this purpose, this paper differentiates between these two forms of "winning" by firms.

The survey used provides supporting data about firms, referred to here as "typing variables". The method of sub-dividing firms by typing variable uses two approaches: discrete classes and the means of the typing variable. These two approaches are complementary in their contributions to the analysis.

5.2. Main conclusions

The impact of "new food policy" instruments on Danish food industry firms appears to depend more on the attributes of the firms (as represented by the typing variables) than on the policies. None of the 30 regulatory areas examined here were shown consistently to affect the distribution of winners and losers, nor to be associated with the mean values of the typing variables. However, several typing variables are shown to consistently determine patterns of winning and losing from policy instruments. These include trade intensity, vertical integration, and the share of sales that are food industry products.

Firms' size and branding behaviour are shown to be of little significance, as is ownership from outside the food industry. This result partially contradicts the view that "new food policies" favour large firms and reinforce industrial concentration: HACCP and other food safety-related compliance being the often-cited example.

In this paper, firm size is shown to affect the distribution of winners and losers from food safety regulations, but the analysis does not confirm that large firms are winners nor that small firms are losers. In general, winners and losers from food safety regulations are not identifiable from the typing variables employed in this study. This may be interpreted as evidence that their impact is somewhat consistent amongst firms. Other policy areas that display little or no association with the typing variables used are recycling of packaging materials and solid waste disposal.

Co-operative legislation, product nomenclature, water use and air quality, and labour law are similarly not associated with many of the typing variables used. These results may be explained either by Denmark's long history with these policy instruments (so that firms have all adjusted accordingly) or an exceptionally good policy design that provides neutrality across typing variables.

Vertical integration was found to be a strong influence on firms' winning and losing from policies. Both the "direction" of vertical integration (upstream or downstream) and its form (by ownership of assets or ownership of firms) appear to be critical determinants of firms' patterns of winning and losing across a range of policy areas. In several policy areas (animal welfare, policy toward co-operatives), firms with high levels of downstream assets win, while those with high levels of upstream assets lose. For many of the policy areas examined here (e.g. environmental policies and those involving information provision), these results are to be expected in a sample dominated by food processors: they are experienced in dealing with those regulatory areas while downstream firms buying upstream assets are not.

Vertical integration by ownership of the firm (rather than by investment in assets) is not a significant typing variable. Many Danish food processing firms are vertically-integrated by ownership (in particular, they are owned by large farmer co-operatives) and the fact that this typing variable is insignificant is of considerable interest for future research.

5.3. Limitations of the research

The research suffers from two weaknesses related to its reliance on survey data. The first is that samples are necessarily small and any classification system reduces the degrees of freedom available to statistical tests. The second is that firms' responses, however categorical, are subject to the respondent's understanding of the question and motivation towards it.

The classification of winners and losers is necessarily arbitrary, and may be criticised for its equivalent treatment of "don't know" and "no response". This partly accounts for the preponderance of "neutral" firms for all policy areas. It is proposed that the application of consistent procedures across all policy areas and typing variables offsets any bias introduced.

A consequence of not asking firms to supply financial data is that classification of winners and losers does not involve measurement of the extent of price and cost increases due to each policy area. The result is that firms that, for example, "lose a little" are classified the same way as firms that "lose a lot". More seriously, different extents of price and cost increases may even alter a firm's classification from winner to loser and vice-versa. However, it is unlikely that sufficient numbers of firms would have responded to questions that required the degree of financial detail to overcome this problem.

The typing variables used are imperfect measures of the concepts under study. Vertical integration, trade intensity, branding behaviour, and several other variables are all measured using survey questions that were, by design, simple and unobtrusive. The simplicity may have resulted in firms' misunderstanding the question, while unobtrusiveness prevents access to financial data.

Overall, the statistical procedures produced consistent and/or complimentary results that were logical and intuitively explicable. However, a small number of anomalies arose in the form of inexplicable significance and insignificance of some tests. It is proposed that these are relatively small effects and do not detract from the results achieved.

5.4. Extensions of the research

The research is suitable for duplication in countries other than Denmark, although adjustments would need to be made to names given to regulatory areas to reflect the different policy environments. Both within and beyond the European Union, much could be gained from an understanding of differential impacts of policies either according to policy area or to firms' characteristics.

A necessary extension of this research is the quantification of net benefits, to allow a more sophisticated classification of winners, neutrals and losers. This would not be feasible in a mail survey, but would be attempted by some high-cost survey method (possibly interviews). More discriminating measures of the typing variables would also sharpen the analysis: candidates include measurement of skill levels in firms' workforce, value added, product ranges and debt loadings. The significance of brand management in the modern food system also justifies an alternative approach to typing variables associated with brands. Beyond the typing variables used here, firms' behaviour is also of interest. The incidence and type of contracting, approach to purchases and sales, use of advertising, debt levels and a range of other variables may further explain firms' capacities to win and lose from policies.

More detailed specification of policies and policy areas would be of benefit in any extension of the research. The current study used laws and regulations drawn from 12 Acts of the Danish parliament. However, the survey questionnaire gave no guidance to firms as to which regulation might generate specific compliance costs and benefits. This could also be addressed in an interview-based procedure.

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